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United States Department of Agriculture,

DIVISION OF BOTANY.

STANDARDS OF THE PURITY AND VITALITY OF AGRICULTURAL SEEDS.

NECESSITY AND OBJECT OF STANDARDS.

In considering a subject of such great importance to the farmer and gardener the necessity and object of standards must be kept in mind. The need is shown in the fact that scarcely two seedsmen have the same idea as to what constitutes first class commercial seed, while many persons who should be the most interested have never given the matter any serious attention whatever. The prevailing idea seems to be that much more seed will be sown anyway than will come up, also that even with rather poor seed more will come up than is needed, necessitating a considerable amount of thinning out; hence the buyer usually depends entirely upon the statements in the seed catalogues or on the packets and often sows a quart where a pint would suffice if the seed were up to a good standard of germination. It is unnecessary to call attention to the fact that the larger the amount sown the more profitable it will be to the dealer, while at the same time it is eminently true that the planter can not afford to be stingy in this matter.

An exceedingly important consideration, generally overlooked, is that a low germination often means more than a lack in quantity. It frequently indicates a matter of vastly more importance—a lack in quality as well; in other words, that the seed is likely to be of different ages, from plants differing in strain, having been grown and gathered under different conditions. Such seed produces very uncertain results, the plants being uneven in their size, time of maturing, and quality, all very serious drawbacks to the farmer or gardener, especially if the crop is grown for sale.

It is insisted, and rightly too, that differences in conditions under which seed is grown and harvested seriously affect its vitality. Seedsmen recognize this fact well, and frequently pay their seed growers accordingly, having previously inspected the crop while growing, if practicable. If from severe drought, an unusually wet season, or other causes the seed crop of peas, for instance, promises to be of poor quality, the seedsman contracts to pay less for it than if conditions were favorable. Would it not be to the best interests of the trade eventually, as well as to those of the agriculturist, if seed whose vitality had been reduced owing to conditions of climate, harvesting, or manner of keeping were sold at a lower price than first-class seed? The farmer and the seed-buying public in general should be in precisely the same position as any other body of purchasers. If a certain standard is adopted for any variety of seed and the price based upon this standard, either wholly or in part, it does not seem reasonable that the public should be expected to pay full price for a given lot of that variety which germinates 50 per cent for example below that standard. The fact that the low germination may be due in this particular case to climatic or other conditions beyond human control does not affect the argument.

BASIS OF STANDARDS.

Standards of purity and germination should be based upon fresh (i. e., not over one year old) seed grown, harvested, and kept under favorable conditions. The low standards of germination suggested by some horticulturists and seedsmen are due largely to the fact that they are based upon tests of ordinary commercial seed, which is often a mixture of different years' growth, part of it raised and harvested under unfavorable conditions. For example, it is no uncommon thing to find standards based in this way: Supposing ten tests of radish seed germinated 95 per cent each; two 90; four 81; five 72; three 26; and two nothing at all; in all, 26 tests, averaging a little less than 73 per cent—according to the custom above mentioned this would be fixed upon as the proper standard. Would any fair-minded person acquainted with the real vitality of fresh radish seed claim that 73 was an adequate germinating per cent in this case? The injustice of such a method would not be lessened if the standard were based on 2,600 or 26,000 tests instead of 26.

Standards of germination can not be considered satisfactory which are based alone upon averages of tests even if the seed is known to be not more than one year old. In such tests there may be many seeds which show a very low germination, even failing to sprout at all, owing to some fault of testing or securing and handling the crop. As previously stated, the buyer should not be expected to pay the same price for such seed, therefore such tests should not be given equal weight in making up the standard; in fact they should not be counted at all.

Standards for germination should be based upon tests conducted in such a way as to reduce the chances of error to a minimum; also by such means as will best bring out the vitality in the different varieties.

All of our experience and information shows that in most instances a germinating chamber in which the heat, moisture, and air supply can be controlled will best secure these results. Furthermore, the process of germination can be more easily watched in this way, and the causes of variation or failure better ascertained and avoided than in tests conducted in soil. Supplementary soil tests should be conducted, however, as a check; also because a few kinds of seeds seem to germinate better in soil than between blotters or cloths in a germinator. For example, Kentucky Blue Grass has been found by numerous experimenters, to show a uniformly higher germination in soil than in the "Geneva Tester" or in a germinating chamber. It may be said in passing that the Geneva pan method has been found inadequate in many cases, especially of smaller seeds.

VALUE OF DIFFERENT GRADES.

A fair standard of germination does not mean that formed by an ideal lot of seed, but a high grade which first-class seed under favorable conditions will attain without difficulty. It is not expected that seedsmen will offer such seed at the same price as that of inferior grades. As it is now, however, with no standards fixed by law or custom, the dealer obtains no more for a lot of seed which will readily germinate at 95 per cent than he does for one of the same variety which shows but 80 per cent vitality, therefore the seedsman who is careless in his crop, farming it out to the cheapest hands, putting little or no scientific study and method into his work, gets the same price as the conscientious and careful man who may raise less seed, but of a much better quality.

It has been said that in the production of new and valuable varieties by hybridization and selection, virility is necessarily sacrificed to a certain extent, hence vitality is not the only criterion of the value of a seed. This is true, but vitality is certainly an exceedingly important criterion, although not the only one. Like that of other articles, the price of a given variety of seed should

depend largely upon its scarcity and cost of production. As a matter of fact, seedsmen usually charge a great deal more for the seed of new varieties than for those which are well established. We believe that the better class of American seedsmen are trying to furnish seed of a high grade, a movement which the Department wishes to encourage in every way as being to the best interest of all concerned. Let us have adequate standards of purity and germination and a corresponding price for seed which meets those requirements.

GENUINENESS OF SEED.

Were the knowledge of American horticulture sufficiently advanced and the obstacles not so great it would certainly be desirable to include the genuineness of seed, or "purity" as the seedsman knows it, in any standard given. This, however, is impracticable at present, as in the case of vegetables an experiment field of large size would be required, and this is not now at our command. Besides, a complete and scientific classification has not yet been made of the multitudinous varieties of garden crops whose seeds are being offered to the farmer and gardener each year. The importance of establishing the genuineness of varieties can scarcely be overestimated, and it is gratifying to note that some of the Experiment Stations, notably Cornell, are doing a great deal of valuable work along this line. The proper study, classification, and description of horticultural varieties of the common vegetables is a very laborious and slow process, however, and inestimable gain will accrue to American horticulture and agriculture if seed be kept up to a high standard of purity and vitality, leaving the matter of genuineness out of the question at present, so far as garden crops are concerned. In the matter of grasses and forage plants, genuineness can be easily established, and should receive a very prominent place in the consideration of the value of the seed.

It should be stated here that the term "purity of seed," as used by the Department, refers only to freedom from foreign material, whether other seeds or inert matter.

VITALITY OF SEEDS.

It is frequently alleged that among vegetable seeds some, especially those of an oily nature, as the cucurbits or "vine seeds" (melon, squash, cucumber, etc.), germinate better when two years old than when but one year old. This, if true, is probably due to the fact that certain chemical changes necessary to bring the reserve materials in such seeds into a proper condition to be used by the plantlet may require more time in oily than in starchy seeds. However, careful experiments are necessary to establish this idea, which can hardly be said to be more than a hypothesis, especially in view of the fact that one-year-old cucurbit seed frequently germinates as high as 95 and sometimes even 100 per cent.

Certain tests with first, second, and third year seeds, showed the vitality to be in every instance considerably less the second year. Cucurbits fell from 80-90 per cent the first year to 70-75 per cent the second, and 60-70 per cent the third. It is unquestionably true that many seeds do not germinate well when perfectly fresh, that is, when first harvested, but require in nature a few weeks or months, sometimes longer, to become thoroughly prepared for germination; on the other hand, some seeds germinate vigorously when first harvested, especially if not quite mature. It is not safe to generalize too much on the behavior of seeds in this respect, since different varieties of the same species often act very differently. Very much depends upon the conditions of climate, growth, harvesting, and manner of keeping as well as upon varietal peculiarities. A great deal also probably depends upon the chemical composition of seeds, the relation of which to germination opens an important

field of study, almost untouched in this country. Whether or not certain varieties of seed germinate better after the first year has no bearing upon the question of standards, since the tests made to ascertain the germinative capacity of any seed are to be conducted the same season that the seed is offered for sale. It would be an easy matter for the dealer to hold back a seed lot from the market until the second year, if its vitality would be improved thereby.

PRESENT STANDARDS OF GERMINATION OF GARDEN SEEDS REQUIRED BY THE DEPARTMENT OF AGRICULTURE.

In the following table the first column of figures indicates the present (1896) germination standards adopted by the Department of Agriculture for some of the more common garden seeds, including the allowance of 5 per cent for variation in tests. The second column is taken for comparison from a work on market gardening, written by a prominent American seedsman,* all of the figures being based on first year seed, grown and harvested under favorable conditions.

Seed.	Standards.		Seed.	Standards.	
	Department.	Seedsman		Department.	Seedsman.
Cabbage.....	90-95	80-95	Okra	80-85	70
Cauliflower.....	80-85	80-95	Beet.....	142.5-150	300+
Turnip.....	90-95	80-95	Onion.....	80-85	70-90+
Carrot	80-85	70-80	Leek.....	80-85	70-90+
Parsley.....	70-75	70-80	Radish.....	90-95	90-95+
Spinach.....	84-89	70-80	Lettuce	85-90	80
Parsnip.....	70-75	70-80	Celery	60-65	80
Cucumber.....	87-92	80-90	Tomato.....	85-90	80
Cantaloupe	87-92	80-90	Peas.....	93-98	95
Squash.....	87-92	80-90	Beans.....	90-95	90-95
Pumpkin.....	87-92	80-90	Corn (flint).....	87.5-92.5	90
Watermelon.....	87-92	80-90	Corn (sugar).....	87.5-92.5	Less than flint.
Pepper.....	80-85	70			
Egg plant.....	80-85	70			

* B. Landreth: Market Gardening, 1893, pp. 47-49.

† Often, if "containing three to five germs per capsule."

‡ American grown.

The fact must be taken into account that the seedsman's figures here given were based upon soil tests which may be expected to show from 5 to 15 per cent lower standing than do germinator tests, upon which the Department's standards are based. It should be said, however, that the book quoted was not consulted in making up the Department standards.

Nevertheless, it should be distinctly borne in mind that the Department standards here suggested are tentative only, having been based upon the best information within our reach at the time they were made. It is not unlikely that a few of them may be a little too high for practical working purposes, while some are almost certainly too low. The fact is most gratifying, however, that a recent proposal to furnish seed for Congressional and Departmental distribution at these standards was readily accepted by prominent seedsmen throughout the country.

Respectfully submitted.

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Approved:

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